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SECTION 16482
VARIABLE FREQUENCY DRIVE CONTROLLERS

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SECTION 16482

VARIABLE FREQUENCY DRIVE CONTROLLERS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The successful bidder shall provide all equipment, material, and labor for the installation, testing, start-up, and commissioning of the variable frequency drive (VFD) systems as shown in the Contract Drawings and these specifications.
- B. The VFD system shall be incorporated into an appropriate control panel enclosure as specified in Section 16912 – “Submersible Pump Station Control Panels,” and these specifications with additional features and characteristics as described herein.

1.02 SUBMITTALS

The following shop drawings and product data shall be submitted.

- A. Equipment outline drawings showing elevation, plan, and interior views, front panel arrangement dimensions, weight, shipping splits, conduit entrances, and anchor bolt patterns.
- B. Power and control schematics including external connections. Show wire terminal numbers.
- C. Drive performance specifications.
- D. Solid-State Soft Starter performance specifications.
- E. Reference books to include User Manual, Installation Instructions, and Programming Guide.
- F. This specification lists the MINIMUM performance requirements for this project. Any exception and/or deviation from this specification **SHALL NOT BE ACCEPTABLE** unless agreed to IN WRITING by the end user department of the City of Savannah.

- G. Written certification that all equipment supplied is in compliance with the most recent version of IEEE-519, IEC/EN 61800 and NEC 70 as applied to the intended end usage of said equipment.

1.03 REFERENCES

- A. IEEE Standards 519 – A Guide for Harmonic Control and Reactive Compensation of Static Power Converters.
- B. National Electric Code (NFPA 70).
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 QUALITY ASSURANCE

- A. Variable frequency drives, solid-state soft starters, and all related products shall consist of the manufacture's most recent production model family suitable for the end-use application.
- B. A factory authorized service and parts organization shall be located within 250 miles of the project location. Provide the name and address of the factory authorized service and parts organization nearest to the project location at the time of bid.
- C. Equipment shall be UL certified and have appropriate label(s) affixed.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package the equipment for maximum protection during delivery and storage.
- B. Store the equipment until ready for installation in an indoor storage facility that is clean, dry, and heated. Do not install the equipment in its final location until the facilities are permanently weather tight. Furnish, install, and wire temporary electric space heaters in the equipment until the permanent heating equipment is operational. Protect the equipment at all times from exposure to moisture, chemicals, hydrogen sulfide gas, and chlorine gas.
- C. If required in the driven equipment specifications, the VFD equipment supplier shall ship the equipment to the driven equipment supplier's testing facility for use during factory acceptance testing.

1.06 SYSTEM DESCRIPTION

A. General: Each system shall consist of:

1. A primary VFD drive system with a solid state soft starter back-up/bypass sub-system comprising the Submersible Pump Drive System contained within the pump control enclosure cabinet.
2. Automatic and Manual operation control components, displays, terminal boards, wiring, and etc. within the pump control enclosure cabinet.

B. Features and Characteristics: Each control shall have the below listed operational features and characteristics as a minimum:

1. Service Conditions:

a. Input Power:

- 1) 200VAC – 240VAC, 3-phase, 50/60Hz for 0.5HP through 100HP depending on actual application.
- 2) 380VAC – 480VAC, 3-phase, 50/60Hz for 1 HP through 700HP depending on actual application.

b. Ambient temperature: -10° C to +50° C.

c. Elevation: Up to 1000 meters above mean sea level.

d. Relative Humidity: 5 – 95% non-condensing.

e. Output Frequency Range: 10 – 10KHz.

f. Output Voltage: 3-phase 0 – up to input line voltage.

g. Automatic Speed Reference Input: 4 – 20 mA on terminals for remote wiring.

h. A panel-mounted, user-adjustable manual speed reference control.

i. Noise level conformity to Directive 86-188/EEC.

j. Terminal block connection points for: (applies to VFD **AND** RVSS)

- 1) 4-20 mA isolated output proportional to motor amps.
- 2) Logic input (open/close contact) input for Run/Stop command.
- 3) Logic input (open/close contact) input for remote E-Stop shut-down and lock-out.
- 4) Logic input (open/close contact) for remote “reset” command.
- 5) Dry contact logic output for remote fault annunciation.

- 6) 4-20 mA isolated input for remote automatic speed reference.
- 7) Input terminals for control power (if different from primary power).

- k. User-operable selector switch to select VFD **or** RVSS operation which disables the sub-system (VFD or RVSS) not being used for operation and enables the sub-system being used for operation. Additionally, the selector switch shall cause the load to be connected to the appropriate drive sub-system.

2. Equipment Control Cabinet Enclosure:

- a. Primary Power Input: Primary 3-phase power (usually 240VAC or 480VAC) shall enter the equipment control cabinet via NEC 70 specified electrical conduit and land on power distribution blocks for re-distribution within the equipment control cabinet. The primary power shall be fed to the control panel from a distributed switchboard or independent molded case circuit breaker **EXTERNAL TO THE CONTROL CABINET**.
- b. All control and monitoring components shall be contained within the same pad-lockable cabinet or wired to a field-accessible terminal board for inter-connection with other equipment.
- c. Control cabinets shall conform to NEMA 1 standards if located inside an environmentally controlled structure (building).
- d. Control cabinet enclosures shall conform to NEMA TYPE 4 standards if located outdoors. The cabinet shall be constructed such that its interior environment is controlled to maintain temperature and humidity levels consistent with the installed equipment optimal operating parameters.

3. Equipment:

- a. The general arrangement of the equipment shall be as shown on the contract drawing(s).
- b. The variable frequency drive(s) (VFD) shall be the most recent production model of Schneider Electric (Square D) **ALTIVAR FAMILY** suitable for use with the driven equipment.

- c. The solid state soft starter(s) (RVSS) shall be the most recent production model of Schneider Electric (Square D) **ALTISTART 48 FAMILY** suitable for use with the driven equipment.
- d. The RVSS sub-system shall be configured with an “up-to-speed” shorting contactor device and associated control circuitry.
- e. The VFD sub-system shall be equipped with “line reactor” device(s) **(or not)** as recommended by the VFD manufacture technical support.

PART 2 - FINAL TESTING AND COMMISSIONING

2.01 PRELIMINARY ACTIONS

- A. Remove **ALL** construction and installation debris from inside and around the immediate vicinity of the control system.
- B. Verify that all internal and inter-connecting wiring is complete, properly marked, and secured with wire management devices.
- C. Verify that all electrical termination points are properly landed and that connections are tight.
- D. Verify that all equipment assemblies and components are properly and completely secured with appropriate fasteners (sheet metal screws **ARE NOT** acceptable).
- E. Touch-up any damaged or marred paint.
- F. Verify that any and all unused penetrations into the equipment are properly sealed.
- G. Replace/clean all filter elements that may restrict cooling air flow in and out of the control cabinet.

2.02 INITIAL SET-UP

- A. With all controls **OFF**, apply power to the system and verify that voltage and phase rotation is correct.
- B. Verify the integrity of **ALL** ground connections to include shielded wiring drain conductors.

- C. Apply remaining control power to the system (**BE CERTAIN THAT THE PUMP “RUN” COMMAND IS NOT ACTIVE!!!**)
- D. Apply initial programming parameters to both the VFD and the RVSS.
- E. Verify correct operation of the sub-system selector switch.
- F. “Bump” pump motor to verify correct direction of rotation of the impeller.

2.03 FINAL OPERATION TEST

- A. With the applicable pump assembly in the wet well and sufficient fluid available in the wet well for pumping; operate the pump in “HAND” utilizing the VFD and the RVSS. Verify that the pump is correctly moving fluid into piping system.
- B. Set all programming parameters on the VFD and the RVSS to end-user requirements.
- C. Demonstrate the automatic operation of the system with both the VFD and RVSS sub-systems on line.
- D. Demonstrate emergency stop and shut-down of the system under both modes of operation.
- E. Demonstrate the correct system reaction to a simulated pump failure. Verify that the system shuts down and that the applicable alarm circuits activate. Accomplish this item under both VFD mode of operation and RVSS operation mode.
- F. Pass over any and all pertinent construction notes and marked-up drawings to the end-user maintenance department personnel.
- G. Pass over at least one (1) copy of the equipment user manual, installation guide, and programming guide to the end user maintenance department personnel.

END OF SECTION 16482